Microbial Burden of Drinking Water Aboard the Space Shuttle and International Space Station

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Drinking water intended for the STS-113 mission aboard the Endeavor OV-105 shuttle, as well as the International Space Station (ISS), was characterized for microbial contamination using conventional and molecular techniques. The city of Cocoa's municipal water, ultimately to be consumed by astronauts aboard the ISS, is treated with biocide (~ 8 ppm Iodide) at KSC and pumped into the space shuttle. Upon arrival at the ISS, this water is transferred to portable storage containers until consumed by astronauts at a distribution system designated SVO-ZV. Humidity condensate is also processed for consumption in a regenerative system designated SRV-K.

This study confirmed the effectiveness of the KSC biocide treatment in removing all cultivable microbes from the drinking water. Untreated municipal water samples contained $1.4x10^4$ CFU/100 mL by conventional plate count analysis, where as ATP-based detection methods showed $1.3x10^5$ microorganisms present, an order of magnitude higher. The regenerated water used for food rehydration in the ISS (SRV-K hot) had $5.1x10^1$ CFU/100 mL cultivable counts. However, the water collected from the SVO-ZV did not reveal any measurable microbial counts. It is interesting to note that both culture and DNA-based methodologies reported the presence of *Acidovorax temperans*, a halogen (biocide) reducing bacterium, from the SRV-K hot water sample.

Molecular microbial community analyses showed bacterial species phylogenetically affiliated with alpha and beta proteobacteria for the municipal water prior to biocide treatment, while only gamma-proteobacteria sequences were seen following treatment. Several 16S rDNA sequences related to opportunistic pathogens, such as *Afipia, Deftia, Propionibacterium,* and *Ochrobactrum*, were retrieved from the ISS water samples. This study did not confirm the presence of active pathogens in the drinking water, however, evidence strongly suggests that implementation of new cultivation approaches to identify the presence of pathogens is essential in accurately assessing inherent health risks to ISS astronauts.